Naval Science & Technology: Enabling the Future Force

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Chief of Naval Research
GWU, April 2013

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
APR 2013		**00-00-2013 to 00-00-2013**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Naval Science & Technology: Enabling the Future Force	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Office of Naval Research ,Chief of Naval Research ,875 N. Randolph Street, Suite 1425,Arlington,VA,22203**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Presented on April 22, 2013, George Washington University, Washington, DC. 2013 Frank Howard Distinguished Lecture

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**28**	

GWU Partnership

Growing Together:

- Engineering
- Bio-Med
- Chemistry
- Computer Science

Investments:

- Over $1.2m

Global Context

- Budget Pressures
- Continuing Conflict in Afghanistan
- WMD Proliferation
- Violent Extremists and Non-State Actors
- Rising Peer Competitors
- Security of Global Commons (Cyber/Piracy)
- Climate Change & Natural Disasters
- Revised Defense Strategy, Re-Balance to Pacific

An Uncertain Dynamic Environment

How the Navy Protects America: America's Away Team

How the Navy Protects America: On, Under and Over the Sea

ON
the sea

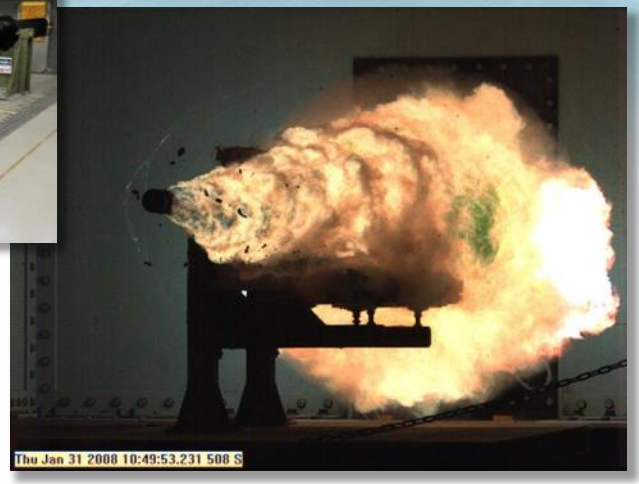
UNDER
The sea

OVER
the sea

How the Navy Protects America: From the Sea

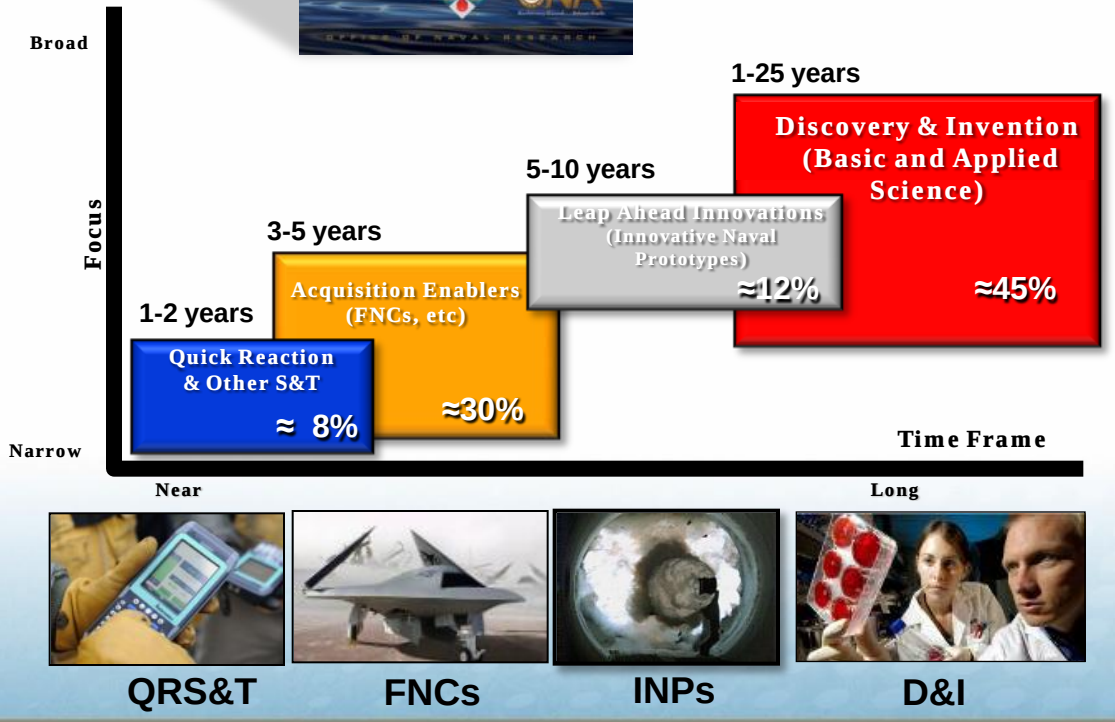
How the Navy Protects America:

Warfighting Advantage Through Science & Technology



90 Years of Na
Office of Naval Research
Science & Technology
USN
estones
S ALL DOMAINS
NTS-2 Satellite in NAVSTAR GPS
Timation and NAVSTAR GPS
Coronal Mass Ejection
Nobel Prize to ONR
Free Electron Laser
© USN Museum
aerofiles.com
Vacuum Packed - Sterile Product
QuikClot
Temporary Traumatic Wound Treatment
To Stop Moderate-to-Severe Bleeding
By Promoting Rapid Coagulation
FOR EMERGENCY EXTERNAL USE
Do Not Eat
See Directions on Back
ARL
Office of Naval Research
S&T
ONR
Revolutionary Research . . . Relevant Results
First Operational Global Ocean Model
CBR Sensors for Fleet Security
World-Record Setting 33 MJ EMRG Shot
NRL Commissioned
1920s
First U.S. Radar Patents
1930s
ONR Founded 1946
1940s
Vertical Take-Off and Landing
1950s
Bathyscaphe Trieste Reaches 35,800 ft.
1960s
Sound Surveillance System (SOSUS)
1970s
Acoustic Microscopy
1980s
Hull Anti-Fouling Coatings
1990s
Remote Environment Monitoring Units
Anti-Torpedo Torpedo
2010 & Beyond

S&T Strategy



S&T Plan Focus Areas:

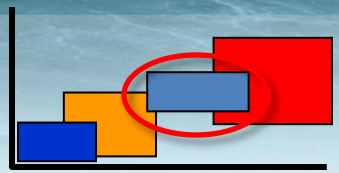
- Autonomy & Unmanned Systems
- Assure Access to Maritime Battlespace
- Information Dominance
- Expeditionary & Irregular Warfare
- Power Projection & Integrated Defense
- Platform Design & Survivability
- Power & Energy
- Warfighter Performance
- Total Ownership Cost

- STEM

Innovative Naval Prototypes

(5-10 Year) Disruptive Technologies

- **High Risk / High Payoff**
- **Innovative and game-changing**
- **Approved by Corporate Board**
- **Delivers prototype**

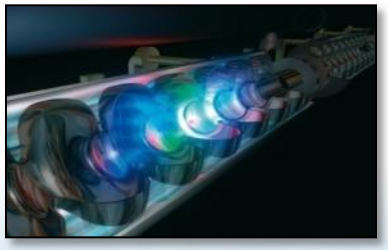


Tactical Satellite

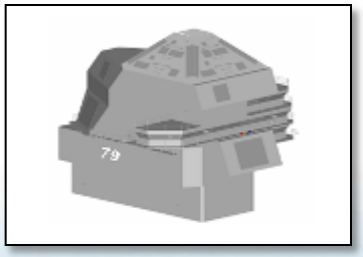
EM Railgun

Persistent Littoral Undersea Surveillance

Sea Base Enablers



Free Electron Laser



Integrated Topside

Large Displacement UUV

AACUS

Directed Energy

“Speed of light” engagement with very precise, affordable real time targeting of UAVs, light aircraft and small watercraft.

<u>Program Goal</u>: Advanced Development Model prototype installed and tested

- Deploy on USS PONCE FY14

Accomplishments to date:

- Demo against UAV & ISR (2010)
- Demo against small boats (2011)
- At sea live fire testing (2011)
- Swarming Combat ID/Targeting (2011)
- At sea tests against UAV (2012)

EM Railgun

General Atomics

BAE

Muzzle energy:
- From 6MJ to 32MJ and beyond
- 50-100nm range capability

Raid Pulsed Power:
- 2.5X increase in energy density
- Multi-shot capable design

Bore Life:
- From 10s to 100s to 1000s
- Multiple configurations & materials

Industry Launcher Prototypes:
- From lab launcher
- To testing General Atomics and BAE guns

Projectile:
- From slugs & sand catch
- To instrumented and dispensing flight bodies on open range

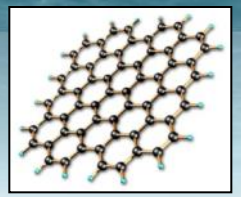
Mission:
- From Land Attack
- To Multi-Mission Initiative

Electromagnetic Railgun INP

Basic Research

Seed corn for disruptive technologies

- Diverse portfolio
- Fosters innovation
- Long-term
- Investment in people
  60+ Nobel laureates



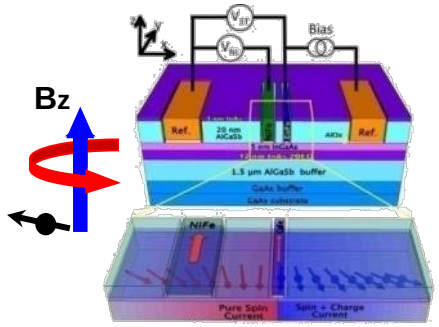
Graphene

1st U.S. Intel satellite
GRAB

Semiconductors
GaAs, GaN, SiC

EW

Spintronics

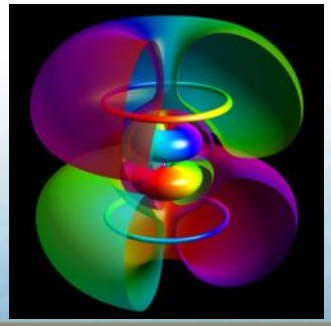


Oceanography
Autonomy

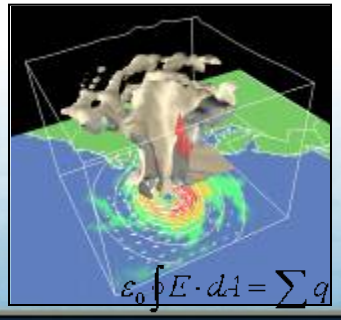
Arctic Research

GPS

Quantum
Physics



Weather Modeling



Laser Cooling

Research Opportunities

Single Investigator Research

- Long-Range Broad Agency Announcement 11-001
- Typical 3 years; average $150K/year
- Basic & Applied Research
- Application is via the ONR Annual BAA

Young Investigator Program (YIP) Awards

University Research Initiatives

- Multi-Discipline University Research Initiative (MURI)
- Defense University Research Instrumentation Program (DURIP)
- Presidential Early Career Award for Scientists & Engineers (PECASE)

STEM Funding

- Seeks proposals in support of STEM: inspiration, engagement, education, and employment in STEM fields
- POC: Dave Han, Deputy Director of Research david.k.han@navy.mil

How We Execute

ONR Global

FFRDCs

UARCs/Academia

Industry

NRL/Warfare Centers

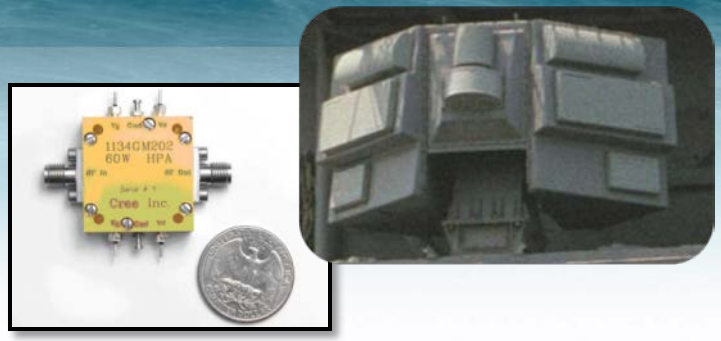
- 30+ Countries
- All 50 States
- 983 Companies
  - 744 small business
- 412 Universities & Nonprofit Entities
  - 3,340 Principal Investigators
  - 3,000 Grad Students

Challenges

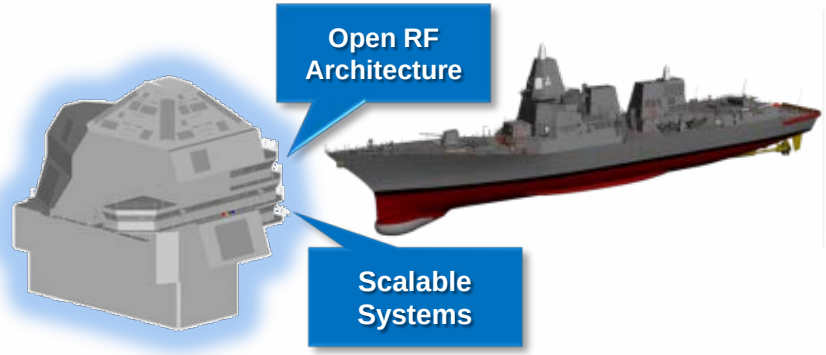
- **Fully integrating manned/unmanned systems**
- **Improved ship, aircraft and weapon effectiveness**
- **Cyberspace and ensuring the electromagnetic spectrum**
- **Warfighter Performance (Training & Medical)**
- **Enabling affordability and reliability**

EM-Cyber Defense

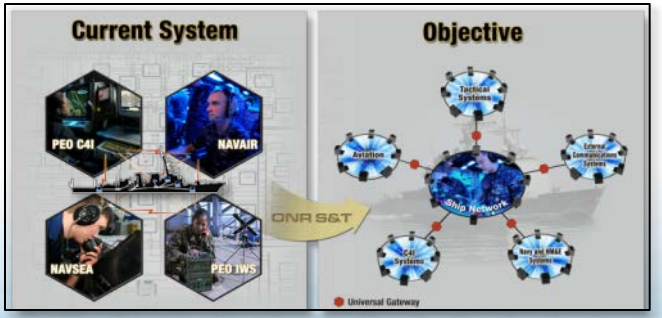
- **Computer Network Defense & Information Assurance**
  - Common Operational Security
  - Advances in GaN semi-conductors
  - High power sensors & electronics



- **Enabling Information Dominance**
  - INTOP: modular, reconfigurable
  - Combining Combat & ISR networks
  - Real-time readiness



- **Universal Gateways**
  - Enables Network-Centric operations
  - Links legacy Combat & C4I systems
  - Manpower and cost savings

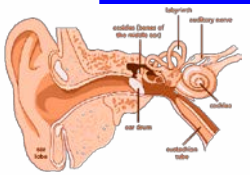


Ensures Data Access and Continuity of EM Operations

Naval Warfighter Performance

Human Systems Integration

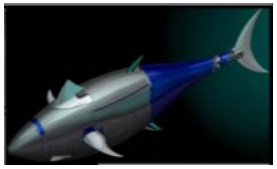
- Manpower & Personnel
- Training
- User-Centered Design
- Command Decision Support
- Human, Social, Cultural Sciences
- Safety / Hearing



Hearing Loss

Bio-Engineered Systems

- Marine Mammal Health
- Bio-Sensors / Materials
- Microbial Fuel Cells
- Bio Robotics
- Human-Autonomy Systems

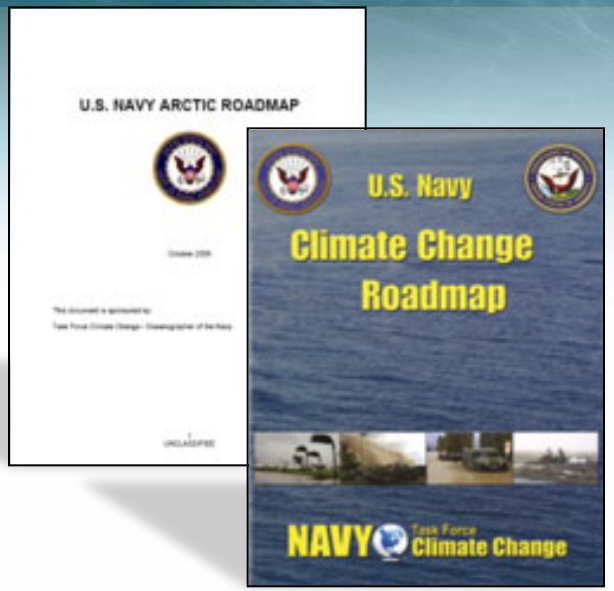


Undersea & Expeditionary Medicine

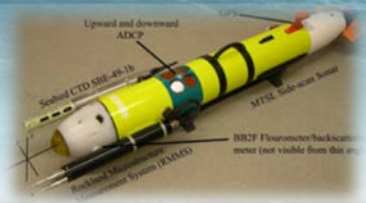
- Undersea Medicine (NNR)
- Point of Injury Care
- Automated Medical Care

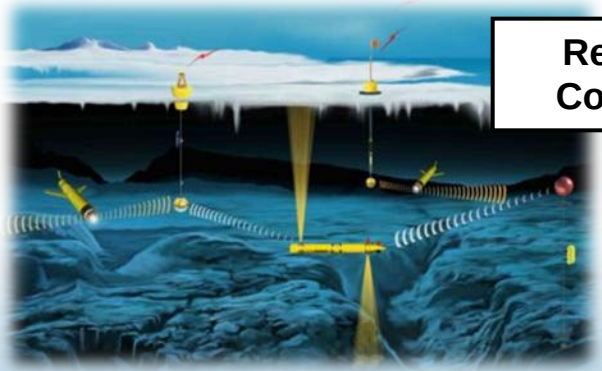
TBI: Infrascanner

Arctic



Novel Sensing Systems





Real-Time Data Communication

Autonomous Platforms and Enabling Technologies

Adjust Naval Operations to Changing Conditions

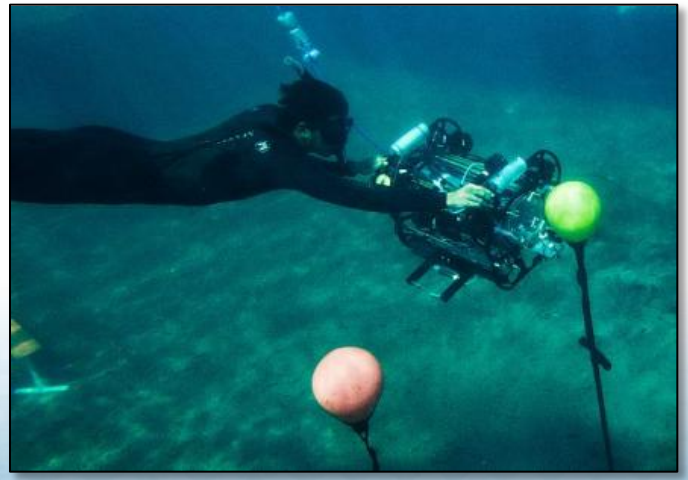
STEM Opportunities

International Submarine Races

For College Students:

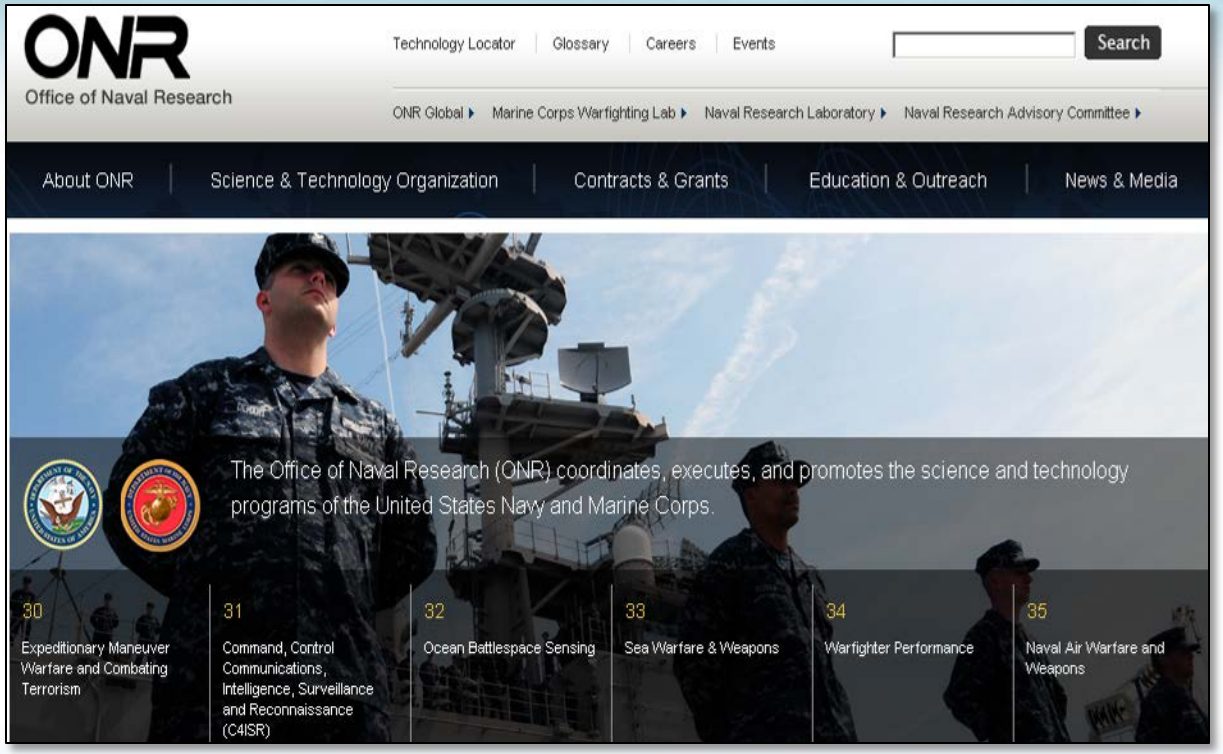
- Summer Internships at Navy Labs
- Naval Research Enterprise Intern Program (NREIP)
- Science, Mathematics & Research for Transformation
- DoD National Defense Science & Engineering Graduate Fellowship Program

RoboBoat



RoboSub

Stay in Touch



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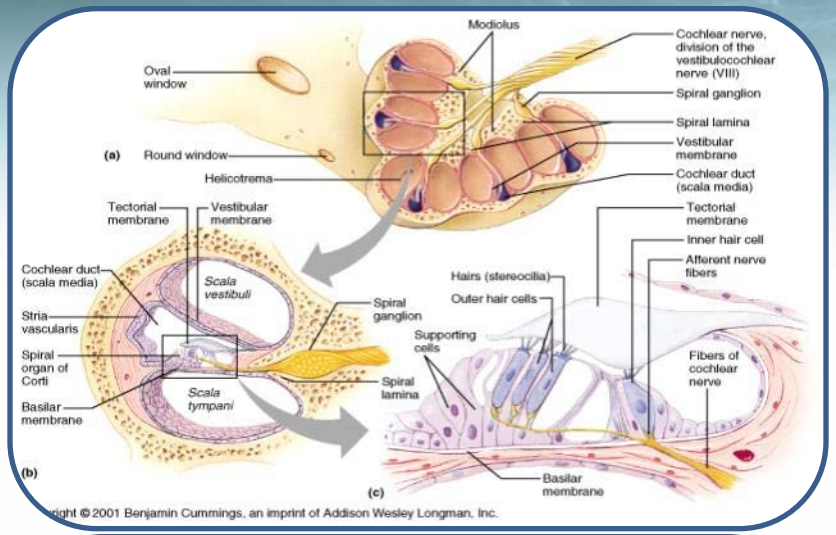
YouTube
Broadcast Yourself™

- Back-up

ONR-Global
Operating Forward

Develop Partnerships
Leverage Global S&T Advances
Avoid Technology Surprise

Noise Induced Hearing Loss



Background:

Hearing loss and tinnitus (ringing in the ears) are the two largest VA benefits. Compromised hearing for active duty military impacts mission readiness, survivability and effectiveness.

Top Research Challenges

- Develop technological solutions to measure, model, and reduce noise
- Develop effective PPE for operational environments
- Understand the etiology of NIHL and tinnitus; develop pharmaceutical interventions
- Improve hearing conservation; develop novel techniques and technologies to measure exposure, susceptibility, and hearing assessment

Mr. Yankaskas (Warfighter Performance ONR34)
kurt.d.yankaskas@navy.mil

Autonomous Critical Care System

Background:

- Over the horizon force projection with operational reach approaching 200 nautical miles (nm) as envisioned in Sea-basing will increase the risk of in-transit clinical degradation of severely wounded casualties.

- Automated critical care is designed to mitigate this risk and to maintain critically injured/ill patients for a minimum of two hours w/o degradation of clinical status.

Top Research Challenges

- Wireless Electrocardiogram
- System failure predictive algorithms
- Casualty transport via UAV

Dr. Michael Given (Warfighter Performance ONR34)
michael.given@navy.mil

Point of Injury Care

Dr. Michael Given (Warfighter Performance ONR34)
michael.given@navy.mil

Background:

Hemorrhage is the leading cause of preventable death on the battlefield. Administration of current resuscitation fluids provides volume but does not help control bleeding and often makes it worse by diluting remaining coagulation factors.

Top Research Challenges

- What are clinically relevant levels for coagulation factors?
- Is pre-hospital administration of dried plasma beneficial?
- How do you control internal bleeding without surgical access?